HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

Fifteenth Progress Report
1 October 2004 through 31 December 2004

Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
U.S. National Weather Service
National Oceanic and Atmospheric Administration
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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk.

Table of Contents

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1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development, U.S. National Weather Service is updating its precipitation frequency estimates for Hawaii. Current precipitation frequency estimates for Hawaii are contained in *Technical Paper No. 43,* "Rainfall-Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years" (U.S. Weather Bureau 1962). The update includes collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The Project will determine annual precipitation frequencies for durations from 5 minutes to 60 days, for average recurrence intervals from 2 to 1,000 years. The Project will review and process rainfall data for the Project area and use accepted statistical methods. The Project results will be published as a Volume of NOAA Atlas 14 on the internet (http://www.nws.noaa.gov/ohd/hdsc) using web pages with the ability to download digital files.

The Project area covers the Hawaiian Islands including Hawaii, Maui, Lanai, Molokai, Oahu, and Kauai. The Project area including preliminary regions is shown in Figure 1.

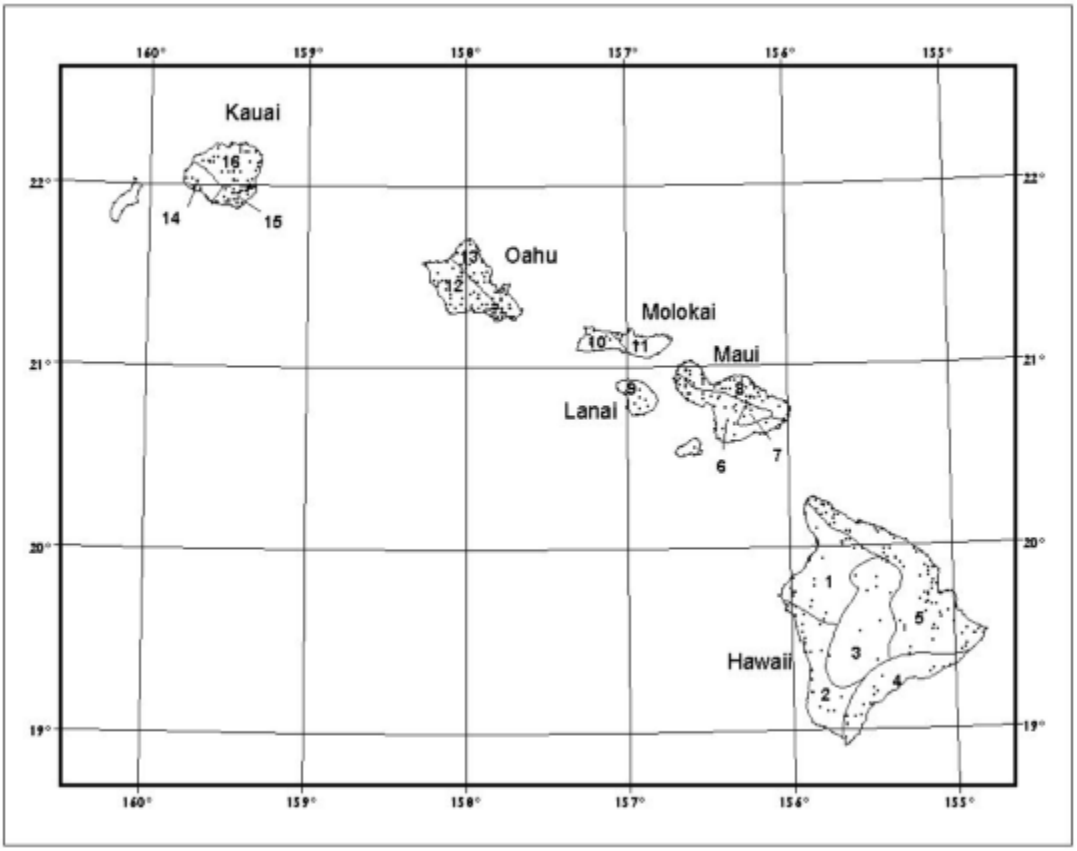

Figure 1. Hawaii Precipitation Frequency Project area, regional divisions and daily station locations.

2. Highlights

Funding has become available for Fiscal Year 2005 (FY05) and therefore it is anticipated that we will be able to start on the Hawaii Precipitation Frequency Project in May 2005. Additional information can be found in Section 4.1, Funding Becomes Available for FY05 and Section 5, Projected Schedule and Remaining Tasks.

Some highlights discussed below are lessons learned from the Semiarid Southwest project, Puerto Rico and Virgin Islands project and the Ohio River Basin and Surrounding States project and therefore are relevant to this project.

Software has been written to improve the data quality control process. First, software to screen 15-minute data for common recurring errors was written. Second, software to screen all maximum values in the time series of all durations is being developed. Additional information is provided in Section 3.1, Software Updates.

The Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information, underwent several subtle, but important changes. The computer server for the PFDS was replaced with a much faster computer which reduces waiting time when downloading results. Additional information is provided in Section 3.2, PFDS.

Progress continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software is 95% complete. There are currently 14 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis. Additional information is provided in Section 3.3, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Software Updates

Additional software has been written to improve the data quality control process. First, software to identify cases where a series of possibly erroneous high values occurred in 15-minute data was developed. A series of high values may indicate where the gauge was malfunctioning. The software creates a log file of such cases to be manually investigated.

Second, a new quality control process is being developed. The goal is to provide an objective process for screening annual maximum series (AMS) and partial duration series (PDS) data to identify maximum precipitation values that are suspect. The process compares an annual maximum (or partial duration maximum) with the values at nearby stations within a given distance on the given observation day. It accounts for the possibility of differing observations times by buffering the observation day with one day before and after the event. Then a percentage of mean annual precipitation is calculated at each station by adding the observation day plus buffer days and dividing by the mean annual precipitation as derived from PRISM grids. The subsequent point percentages are spatially distributed and then heavily smoothed. The difference in point percentages between the smoothed and unsmoothed grids at the target station is, in part, used to determine whether a particular maximum is suspect or not. Other indicators of values include station density, spatial variability, and the highest station precipitation reported within the radius of influence. Efforts are being made so that the difference threshold can vary in space and time depending on the terrain and expected type of precipitation. The advantage of this quality control screening process is that it not only captures cases where a maximum is too high, but it can also capture cases where an annual maximum is too low relative to nearby stations. Such stations and dates are identified for further manual quality control.

3.2 Precipitation Frequency Data Server

The Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information, underwent several subtle, but important changes. They include:

1. Added several frequently asked questions (FAQ) to the FAQ page.
2. Added this important cartographic map usage caveat to the “GIS Data and Maps” page:

   The color maps should not be used for interpolating point or areal precipitation frequency estimates. Point and areal values should be obtained from the PFDS interface which gets data directly from the high resolution grids. The color maps were created to serve as visual aids only.

3. Continued to update the PFDS Performance and Stats page on a monthly basis (see below).
4. Made several subtle changes to the NOAA Atlas 14 Download page, however plans are underway to make this page even more user-friendly in the future.
5. Reorganized state-specific pages
    a. Moved buttons to ancillary information to top of page
    b. Added NWS background to top of page
    c. Added FAQ button

On December 12, 2004 the PFDS server was replaced with a much faster computer which reduces waiting time when downloading results.

HDSC continuously monitors the hits, integrity and performance of the PFDS. The graph (Figure 2) below summarizes the number of individual data inquires made since January 2004, while the map (Figure 3) indicates the locations of inquires during the past quarter.

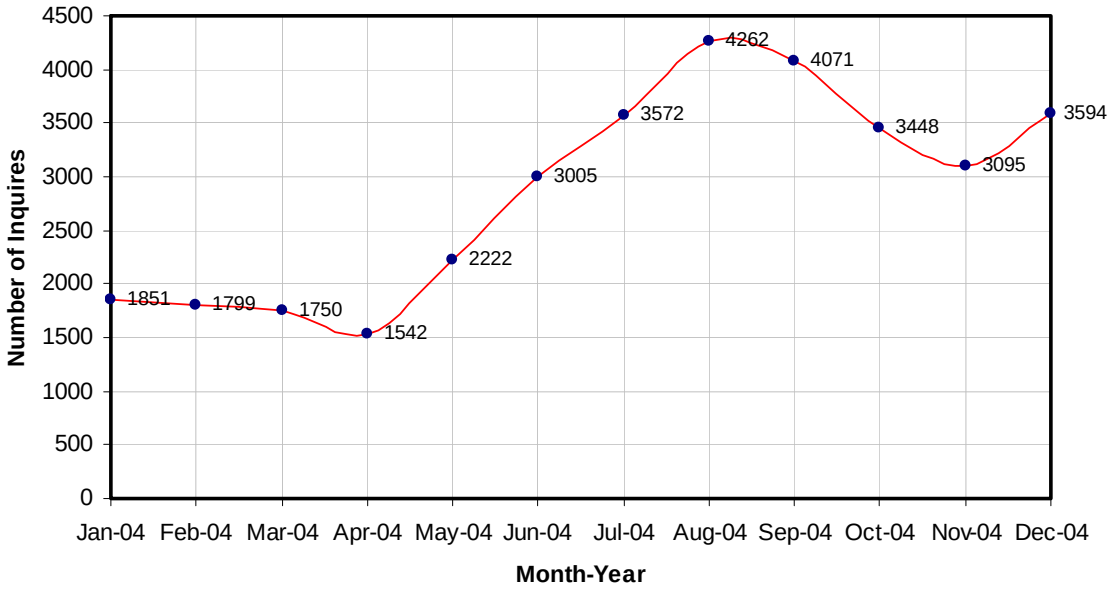

Figure 2: Number of individual PFDS data inquires per month.

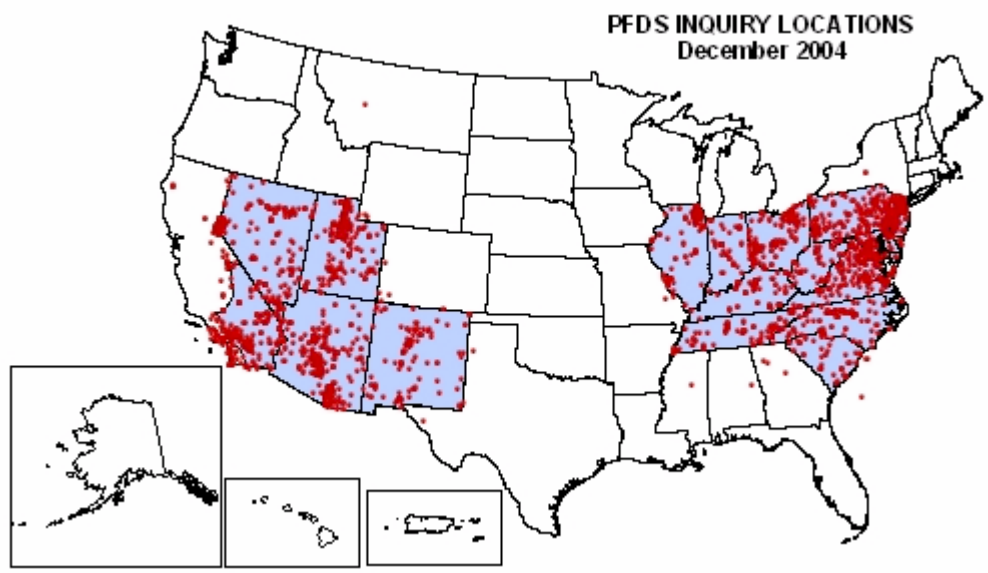

Figure 3: Map of 10,137 PFDS data inquiry locations during the period October-December 2004.

3.3 Areal Reduction Factors

Progress continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software from the procedure described in NOAA Technical Report NWS 24 continues and is 95% completed.

Quality control of the recently added study area, Santa Barbara County, CA has been completed. The Chickasha, OK study area has been put on hold pending permission from the Oklohoma Mesonet for use of the data. The Ventura County, CA study area was eliminated due to unsuitable data records. Currently, there are 14 sites located throughout the conterminous US, Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis (see Figure 4). The “not used” study areas indicated in Figure 4 were considered but judged inadequate for the study due to lack of station density, poor data, limited or no metadata, or other problems.

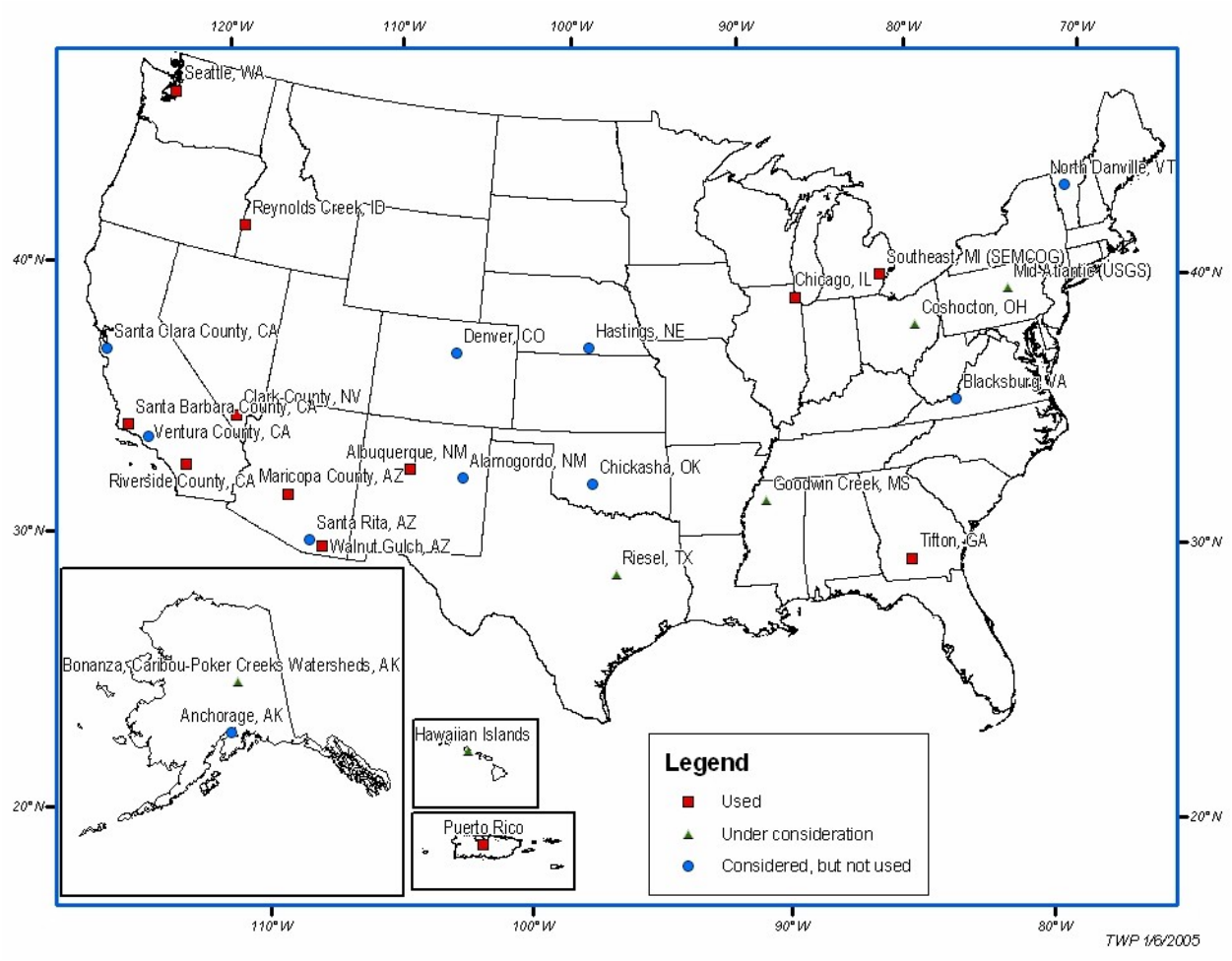

Figure 4: Map of ARF study areas

4. Issues

4.1 Funding Becomes Available for Fiscal Year 2005 (FY05)

Funding has become available for FY05 from the US Army Corps of Engineers and NWS sources. Therefore, we anticipate work will begin on the Hawaii Precipitation Frequency Project in May 2005. However, funding for FY06 must be maintained at the same level in order to meet the schedule set below.

4.2 International Cooperation

Members of HDSC were invited to the Nanjing Hydraulic Research Institute (NHRI) in Nanjing, China to demonstrate the techniques used on this project. Geoff Bonnin, Bingzhang Lin and Debbie Todd presented a seminar on December 9-10th, 2004. The seminar focused on the theory and practical application of regional precipitation frequency analysis using L-moments as used in HDSC. Members of various agencies of the Chinese Ministry of Water Resources (MWR) and various other agencies and Universities attended. These agencies included the NHRI Department of Hydrology and Water Resources, UNESCO-IHP Intergovernmental Council Bureau and Institute for Water Education, MWR Bureau of Hydrology and Office for National Flood Controlling and Commanding System, Reconnaissance, Planning, Design and Research Institute of Yellow River Conservancy Commission, Hohai University, and Tongji University. The scientific exchange was well received and generated interest in future collaboration.

The series of presentations included:

- *Recent Updates to U.S. Rainfall Frequency Estimates: Overview* by Geoff Bonnin
- *Seminar on Regional L-moments Analysis Method* by Bingzhang Lin
- *Implementation of Regional Precipitation Frequency Analysis using L-Moments* by Debbie Todd
- *Recent Updates to U.S. Rainfall Frequency Estimates: Spatial Analysis* by Geoff Bonnin
- *Recent Updates to U.S. Rainfall Frequency Estimates: Program Management* by Geoff Bonnin

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks that will be worked on during the next few quarters are also included in this section.

Data Collection and Quality Control [July 2005]
L-Moment Analysis/Frequency Distribution [November 2005]
Trend Analysis [September 2005]
Temporal Distributions of Extreme Rainfall [December 2005]
Spatial Interpolation [February 2006]
Peer Review of Spatially Distributed Estimates [March 2006]
Precipitation Frequency Maps [May 2006]
Web Publication [May 2006]

Areal Reduction Factors [May 2005]

5.1 Data Collection and Quality Control.

Starting in May 2005 we will obtain appropriate NCDC and other available data and then start the quality control and testing of the regionalization. The estimation of the appropriate probability distribution functions and the parameterization of these functions as well as the spatial interpolation steps will be done for all islands as a group to ensure consistency in this part of the process.

5.2 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 14 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

References

Bonnin, G., D. Todd, T. Parzybok, B. Lin, D. Riley, and M. Yekta, 2004: Precipitation frequency atlas of the United States. NOAA Atlas 14 Volume 1, Silver Spring, Maryland. http://hdsc.nws.noaa.gov/hdsc/.

Frederick, R.H., V.A. Myers and E.P. Auciello, 1977: Five to 60-minute precipitation frequency for the Eastern and Central United States, NOAA Technical Memo. NWS HYDRO-35, Silver Spring, MD, 36 pp.

Hershfield, D.M., 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years, *Weather Bureau Technical Paper No. 40*, U.S. Weather Bureau. Washington, D.C., 115 pp.

Hosking, J.R.M. and J.R. Wallis, 1997: *Regional frequency analysis, an approach based on L-moments*, Cambridge University Press, 224 pp.

Huff, F. A., 1990: Time Distributions of Heavy Rainstorms in Illinois. Illinois State Water Survey, Champaign, 173, 17pp.

Institution of Engineers, Australia, 1987: *Australian Rainfall and Runoff, 3rd Edition*, The Institution of Engineers, Australia. Canberra.

Lin, B. and L.T. Julian, 2001: Trend and shift statistics on annual maximum precipitation in the Ohio River Basin over the last century. Symposium on Precipitation Extremes: Prediction, Impacts, and Responses, 81st AMS annual meeting. Albuquerque, New Mexico.

Miller, J.F., 1964: Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States, *Technical Paper No. 49*, U.S. Weather Bureau and U.S. Department of Agriculture, 29 pp.

Miller, J.F., R.H. Frederick and R.J. Tracy, 1973: Precipitation-frequency atlas of the western United States, *NOAA Atlas 2*, 11 vols., National Weather Service, Silver Spring, MD.

Myers, V.A., and R.M. Zehr, A Methodology for Point-to-Area Rainfall Frequency Ratios, NOAA Technical Report NWS 24, Office of Hydrology, National Weather Service, Silver Spring, Maryland, February 1980.

U.S. Weather Bureau, 1962: Rainfall-Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years, *Weather Bureau Technical Paper No. 43*, U.S. Weather Bureau. Washington, D.C., 60 pp.